HORMONE CONTENT OF NORMAL AND CYSTIC OVARIES OF SWINE

BY

RAY LEROY HAYS

A.B., University of Illinois, 1941
M.S., University of Illinois, 1947

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PHYSIOLOGY
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HORMONE CONTENT OF NORMAL AND CYSTIC OVARIES OF SWINE

It is known that some types of sterility in swine as well as in other species are caused by cystic ovaries. The cystic ovary is pathological and involves enlargement of graafian follicles or other fluid filled cavities in the ovaries. The present study is primarily concerned with the analysis of the hormone content of normal and cystic ovaries of swine.

It has been noticed in sows that an enlarged clitoris is often associated with cystic ovaries. The clitoris can be stimulated to enlarge by the presence of androgen or large amounts of progesterone. Thus an enlarged clitoris indicates an abnormal condition in the sow.

Ovarian cysts can be produced in experimental animals by the administration of progesterone or gonadotrophins, parabiosis of a hypophysectomized female and a castrate male, implantation of testes into females, removal of one ovary or severe trauma of the ovaries. The above list, taken collectively, definitely indicates that an upset in the balance between the anterior pituitary gonadotrophins and the female sex hormones will cause cystic ovaries.

Normal and cystic ovaries were collected at the Rose Packing Company, Danville, Illinois and the Swift Packing Company, Chicago, Illinois. Only cystic ovaries which contained more than thirty cubic centimeters of fluid per pair were collected. The ovaries were frozen as soon as possible after collection. The fluid was extracted with ethylene dichloride. The residue was dried and reextracted. The ovaries minus the cystic fluid were treated in a similar manner except that the tissue was ground in a mortar with sand before it was extracted.

For the estrogen assay, 21 to 23 day old ovariectomized Sprague Dawley rats were injected nine times in 4½ days.

The injections were made subcutaneously in 0.1 cubic centimeter of Mazola oil. The rats were killed with ether on the fifth day. The uteri were taken out and weighed to the nearest 0.1 milligram.

In order to convert the results to a common basis, it was necessary to construct a standard curve of the relation of rat uterine weight to known amounts of estradiol injected. The curve was a straight line up to a dose of 0.45 gamma. The fiducial limits were flat and narrow indicating that the variability was small and that there was very little error in the regression line. The standard deviation of the regression was 0.00635. The line based on 88 experimental and 22 control rats reached a plateau at a dose of 0.45 gamma and doses up to 1.8 gamma cause no increase in uterine weight over that caused by a dose of 0.45 gamma.

During the collection of cystic sow ovaries, it was found that most of the cysts were follicular in origin. The follicular cysts were divided into two different and distinct types. Firstly, the "large" type cystic ovaries contained in each ovary from one to twelve cysts which measured from 15 to 56 millimeters in diameter. Secondly, the "grape" type cystic ovaries contained in each ovary from 12 to 34 cysts which measured from 12 to 21 millimeters in diameter. The latter name was derived from the appearance of the ovary which looked like a cluster of grapes because of the many purpilish, hemorrhagic cysts. As a general rule, the grape type ovaries contained more cysts and the large type ovaries contained less cysts than the normal number of mature follicles.

The concentration of estrogen in the fluids and tissues of the different large cystic ovaries was approximately the same and while it caused statistically significant increases in uterine weights of the test animals, the amount was so small that it could not be measured accurately. The lower concentration was not due merely to dilution since the total amount present was far less than that found in normal ovaries. The grape type ovaries contained an equivalent of 0.031 to 0.043 gamma

of estradiol per cubic centimeter of fluid or gram of tissue. This indicated that these ovaries were secreting estrogen at a normal rate if considered on a basis of a unit of secreting tissue. However, the total amount of estrogen in the ovaries was four or five times that found in normal ovaries.

To study the effect of gonadotrophins on the ovaries, three pregnant sows were injected with 150 to 300 Cartland Nelson units (CNU) of pregnant mare serum and killed five and six days later; one sow was injected with 300 CNU and killed eleven days later. The former group had in each ovary 25 to 44 large follicles or cysts which measured from 8 to 18 millimeters in diameter. The latter had in each ovary 11 to 13 large follicles or cysts which measured from 8 to 25 millimeters in diameter. The estrogen concentration of the ovarian tissue and fluid of the first group was in the same range as that in follicular fluid and the fluid and tissue of grape type ovaries. The estrogen concentration of the ovarian fluid and tissue of the animal slaughtered eleven days after injection was less than half that found in the first group.

In order to study the site of estrogen formation within the ovary, normal cycling ovaries were obtained and their component parts analyzed. Eight single normal ovaries having mature follicles measuring from ten to twelve millimeters in diameter were used. The follicular fluid was taken out and the theca folliculi and the granulosa carefully cut out. The tissue of the corpora lutea was scraped out. These parts and the residual tissue were extracted separately in the manner described earlier. Additional samples of follicular fluid and corpora lutea were collected in a similar manner. There was a higher estrogen concentration in the combined theca and granulosa than any other part of the ovary except the follicular fluid. On the other hand, there were relatively large amounts of estrogen in the corpora lutea and in the stroma.

The fluid and tissue of cystic ovaries, follicular fluid and corpora lutea were assayed for progesterone by a modified McGinty technique. The test uteri were so swollen that it was

impossible to interpret the results. The uteri of six out of seven sows with large cystic ovaries showed progesterone stimulation. The uteri were histologically similar to those found in normal animals at about the seventh day of the estrual cycle. The uterine epithelium was wrinkled and the endometrium contained a large number of uterine glands which were characterized by thick epithelia and small lumina. The uteri of sows with the grape type ovaries showed an intense estrogen stimulation so the amount of progesterone stimulation could not be determined.

Conclusions

1. The large type cystic ovaries of sows produce very little estrogen, but they produce progesterone in amounts approximately equal to those produced by normal ovaries in the luteal phase of the estrual cycle.

2. The grape type cystic ovaries of sows produce more estrogen than do normal ovaries in either phase of the estrual cycle. The increase in estrogen production is due to the increase in estrogen-secreting tissue and not due to an increased activity of this tissue.

3. The cystic ovaries caused by the injection of pregnant mare serum into pregnant sows produce more estrogen than do normal ovaries in either phase of the estrual cycle. This is also due to an increase of estrogen-secreting tissue.

4. In normal ovaries the theca externa, theca interna and granulosa combined are the primary source of estrogen. From this study, no conclusions could be drawn regarding the relative amount produced by each of these three layers.

5. The concentration of estrogen in the follicular fluid was slightly less than that in the follicle wall. The concentration of estrogen in the follicle wall was four times that in the ovarian stroma.

VITA

Ray Leroy Hays was born at Salem, Illinois on December 8, 1919. He attended grammar school at Ewing, Illinois and high school at Salem, Illinois. In September, 1937 he entered the University of Illinois and received the degree of Bachelor of Arts from there in June, 1941. He served in the military service from July, 1941 to December, 1945. In September, 1946, he entered the Graduate School at the University of Illinois and received the degree of Master of Science in September, 1947. He served as an assistant in the Department of Zoology and Physiology from September, 1946 to June, 1949.

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